Effects of fillers on the properties of liquid silicone rubbers (LSRs)

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Effects of Fillers Depend On

- Particle Size
- Particle Surface Area
- Particle Shape
- Particle Surface Activity

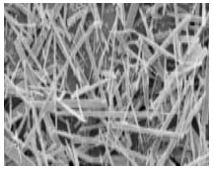
(Compatibility With/Adhesion To Matrix)

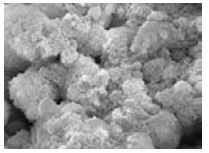
Particle Shape
Broader (and Longer) is Better

Isometric 

Platy 

Fiber 

Acicular 

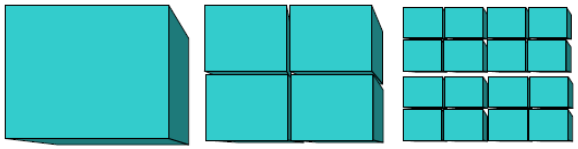
Cluster 

Particle Size
Smaller is Better

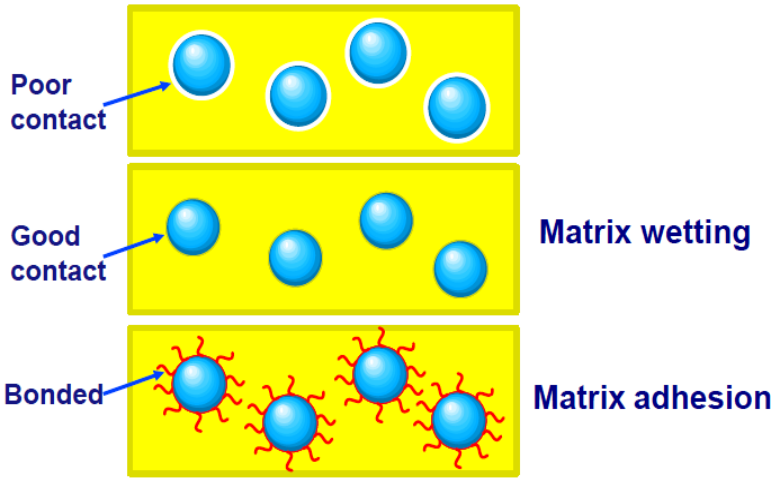
- >10µm: Degradants
- 1-10µm: Diluents
- 0.1-1µm: Semi-reinforcing
- 0.01-0.1µm: Reinforcing

Particle Surface Area
Bigger is Better

size ↓ surface area ↑



Particle Surface Activity
More is Better



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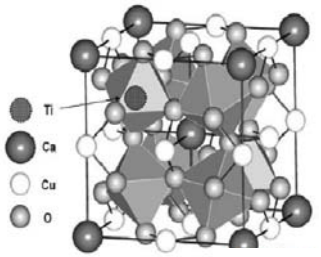
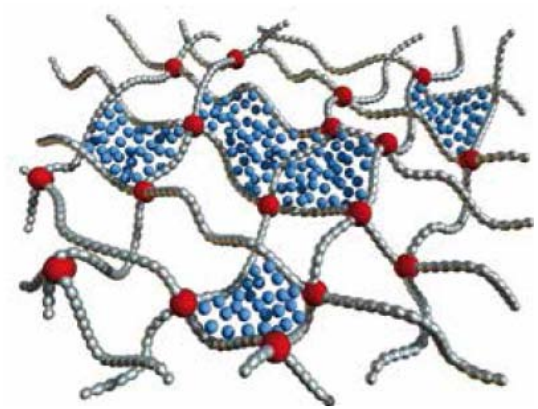
SiO_2 reinforces the networks with no increase in permittivity ($\varepsilon_{r,SiO2} \sim 3.9$).

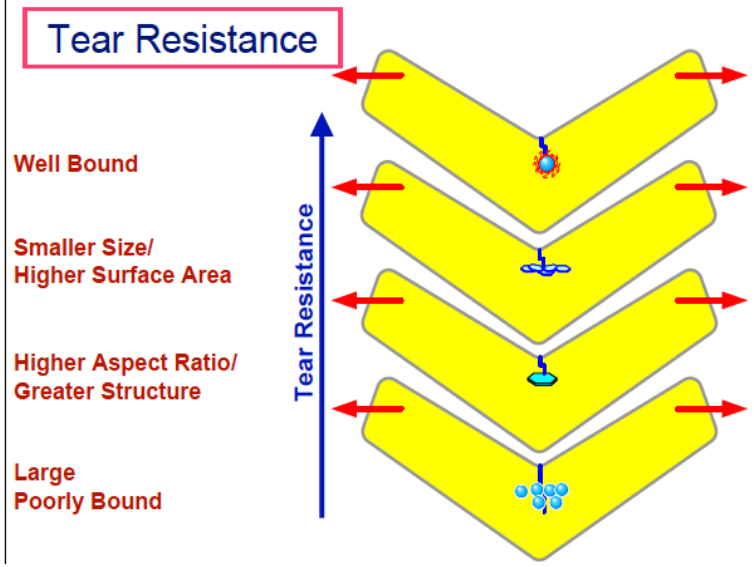
The inhomogeneous compatibility of the unmodified multiwalled carbon nanotubes (MWCNTs) causes the risk of conductivity.

Micron-sized $CaCu_3Ti_4O_{12}$ CCTO ($\varepsilon_{r,CCTO} \sim 10000$) decreases the mechanical properties of the composites.





Polymer with chemical crosslinks (red) forms a filled, elastic network



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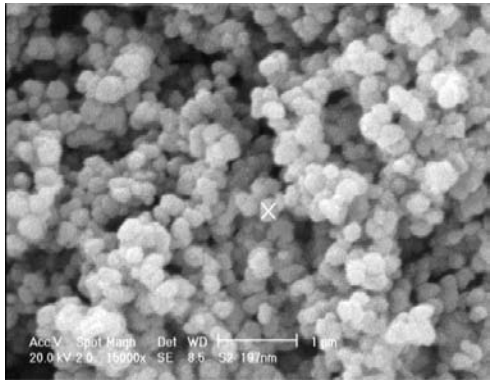
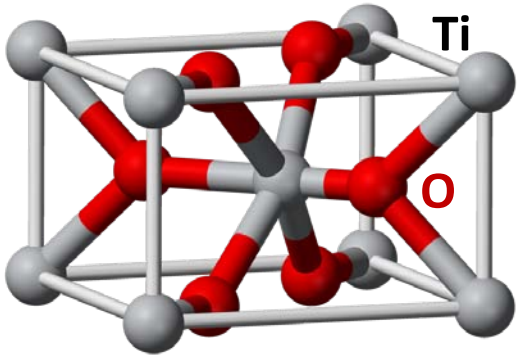
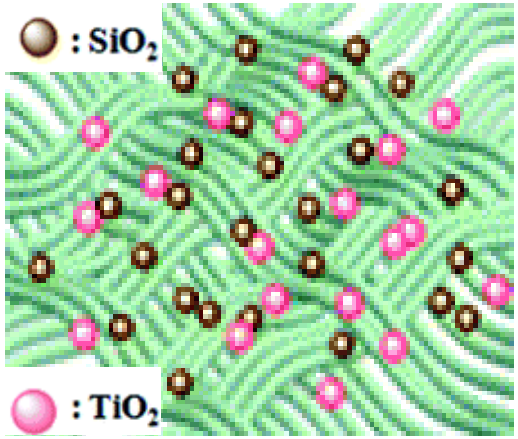


Nano-sized: 25-250nm
Spherical particle



Rutile ε_r : 114-180



Hydrophobic: modified polysiloxane

	Tear strength (N/mm)	Relative permittivity ε_r @ 0.1Hz	Young's modulus Y (MPa)	Breakdown strength (V/µm)
LSR	6.6	2.8	0.8	130
LSR/TiO_2	20	5.5	1.0	150

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